



**Washington State
Department of Transportation**

Construction Traffic Mitigation Demand Management Evaluation

I-405 South Bellevue and Renton Stage 1

Public Transportation Division

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I-405 South Bellevue and Renton Stage 1 Construction Traffic Mitigation Demand Management Evaluation

In 2007 and 2008, construction for the South Bellevue Widening (112th Ave SE to SE 8th St) and Renton Stage 1 (I-5 to SR 169) projects narrowed lanes, reduced shoulders and performed construction that was visible to drivers. WSDOT's Public Transportation Division worked with the I-405 project team and local agencies to design a plan that helped keep people and goods moving during construction by:

- Reducing single occupant vehicle (SOV) trips in the I-405 corridor
- Leveraging WSDOT's resources and private, local and regional investments
- Measuring performance and documenting lessons learned about transportation demand management (TDM) implementation for future construction projects

Implementation of the resulting TDM plan helped keep traffic moving while crews completed construction and helped WSDOT to comply with commitments listed in the I-405 Corridor Program Final Environmental Impact Statement and Master Plan.

Investment Strategy	Total Cost	Vehicle trip reduction daily round trips		Implementation Timeline	Total one-way trips reduced during project	Average daily cost per one-way trip reduced
		Target	Actual			
Promote carpooling	\$95,340	330	142	1/2008 - 12/2008	71,000	~\$1.3
Outreach to residents	\$72,322	183	95	6/2008 - 11/2008	23,750	~\$3.0
Outreach to Bellevue employers	\$75,082	171	264	1/2008 - 12/2008 ¹	132,000	~\$0.6
Outreach to south King County employers	\$37,374	135	163	10/2007 - 12/2008 ¹	101,875	~\$0.4
Relocate vanpools	\$54,000	180	180	4/2007 - 8/2008	127,500	~\$0.4
Outreach to Bellevue employees	\$11,068	108	92	4/2008 - 12/2008	34,500	~\$0.3
Install and promote bicycle lockers	\$16,235	16	7	Installed June 2008	1,750	~\$9.3 ²
Promote vanshare	\$4,560	24	65	1/2008 - 12/2008 ³	32,500	~\$0.1
SUBTOTAL	\$365,981	1,147	1,008		524,875	\$0.7⁴
Commute trip reduction	-	-	1,232 ⁵	10/2007 - 12/2008	770,000	-
Vanpools	-	-	462 ⁵	10/2007 - 12/2008	288,750	-
TOTAL	-	-	2,702	-	1,583,625	-

¹ Outreach to Bellevue and south King County employers included FlexPass sales. FlexPasses are valid for one year so the benefits of the program extend beyond the contract. Daily cost is based on the contract period ending December 2008. Historically the retention of FlexPass programs by employers is high.

² Bicycle lockers remain at the park and rides for use after construction. Daily cost is based on the contract period ending December 2008.

³ Vanshare participation continues beyond the end of the contract. Retention of vanshare groups is historically high with groups lasting an average of 3 years. The benefits of this program last beyond the end of the contract.

⁴ Average cost per trip for activities directly funded for construction mitigation.

⁵ These programs are ongoing and statewide in nature and were not specifically implemented to support I-405 construction traffic mitigation. The estimates are representative of the I-405 corridor and the change from before to during construction.

The construction mitigation program's overall goal was to reduce 1,147 daily round trips. The projects implemented specifically to support I-405 construction traffic mitigation reduced 1,008 daily round trips, about 12 percent less than the goal. However, ongoing, statewide CTR and vanpool programs reduced an additional 1,694 daily round trips on the I-405 corridor, totaling 2,702 trips removed.

Establishing mitigation targets

Before this construction was underway, WSDOT analyzed the construction plan and developed demand management strategies to help maintain traffic flow during construction. The analysis indicated about 1,150 round trips needed to be removed from I-405 each weekday during the peak periods (6 to 9 a.m. and 3 to 7 p.m.) to maintain pre-construction traffic flow.

Performance measurements show we reduced between 2,604 and 2,800 daily round SOV trips in the I-405 corridor during the South Bellevue and Renton Stage 1 construction activities. It is important to note that during this same time, record high gas prices prompted people to drive less for the first time in nearly three decades, causing shifts in driving habits.

Analysis of the corridor revealed a large number of commuters' trips were originating from the south King County area (where transit is limited) and traveling to Bellevue. We also reviewed TDM activities implemented during the Kirkland Stage 1 Widening project to help us determine what would work best for the Bellevue-Renton project. To help reduce travel demand during construction on the affected corridor, WSDOT strategically chose to promote vanpooling, carpooling, vansharing and transit and increased the availability of parking at crowded park and ride lots in the I-405 corridor.

Measuring performance

The objectives of the mitigation investments were to reduce vehicle trips on the corridor during construction as a way to maintain traffic flow through the construction zone. Performance measurement was designed to identify the impacts of individual investments.

Trip reduction targets

Trip reduction targets were set in advance for individual demand management elements of the plan. However we were unable to assess performance of individual program elements during implementation due to data collection processes. Post project assessments were possible and are included within this report.

Lessons learned

For future reporting, WSDOT will collaborate with Metro to develop data collection plans prior to implementing TDM activities to ensure timely availability of data for decision-making and reporting. We recognize that some programs will always experience a lag in the availability of data.

Selecting mitigation strategies

We developed these strategies with a few key considerations in mind:

- Build on existing trip reduction programs: we developed our trip reduction strategies to build upon existing trip reduction programs, from existing bus service to longstanding commute trip reduction programs at worksites. Our strategies were designed to leverage these existing investments and complement these programs.
- Develop trip targets using traffic analysis and data: we analyzed the likely impacts of construction on traffic and developed trip reduction targets that would keep traffic at pre-construction levels. We then selected strategies designed to reduce trips during peak commute times and on key routes to meet these targets.

- Consider what worked in the past: we reviewed current and past construction traffic trip reduction programs with local partners. Together we assessed which past programs worked well and which programs might be most suitable to reach our trip reduction targets. We dismissed programs not likely to be effective given the specific construction impacts.

Mitigation Strategies

Investment strategy	Target market	Why this strategy
Promote and offer carpool incentives	I-405 corridor drivers	Research shows that commuters in east King County are receptive to the idea of carpooling and traffic data indicates that there are a lot of empty seats in vehicles on the I-405 corridor. Also, CTR data showed that many I-405 commuters had common origins and destinations in numbers significant enough to support carpools.
Outreach and incentive program to get residents to commit to reduce their drive-alone trips	Central Renton and Renton Highlands residents that commute on the I-405 corridor	Past home-based outreach programs showed that providing information about highway construction, transit, carpool, vanpools, walking, bicycling, trip chaining and shopping closer to home and getting local businesses and residents to commit to trip reduction would help reduce highway trips.
Outreach to downtown Bellevue employers, offering commute assistance and incentives for those who join the FlexPass program	Commuters on I-405	The popular FlexPass program offers transit benefits to commuters. Data shows incentives can help attract new businesses to provide the passes and that those who join continue the program even after the incentives diminish. With FlexPasses, commuters incorporate non-SOV modes into their routine workday, reducing trips during rush hours.
Outreach to south King County employers, offering commute assistance and incentives for those who join the FlexPass program	Commuters on I-405 and SR 167	The popular FlexPass program offers transit benefits to commuters. Data shows incentives can help attract new businesses to provide the passes and that those who join continue the program even after the incentives diminish. With FlexPasses, commuters incorporate non-SOV modes into their routine workday, reducing trips during rush hours.
Relocate vanpools from crowded park and rides to free up parking spaces	Potential bus and vanpool riders	Buses on key routes still had seats available but overcrowded park and ride lots deterred new riders. Relocating vanpools frees-up parking spaces at these park and rides, which opens up parking spaces for more transit users while maintaining vanpool participation.
Outreach to downtown Bellevue hospitality employees (non-CTR businesses)	Over 8,000 retail, restaurant, hotel employees who commute on I-405 and SR 167	Program offers CTR-like benefits to low-income and reverse commute employees. This previously untapped market had potential due to their desire to reduce their commute costs.
Install and promote bicycle lockers at crowded park and rides along I-405	Potential bicyclers and transit riders	Existing bike lockers were full and at one park and ride were non-existent. There was demand for additional bike lockers. Providing the lockers would encourage people to bike to the park and ride, which would free up parking space for additional transit riders. Bike lockers provide a long-term benefit because they remain after construction.
Promote vansharing to commuters employed 10 miles or less from the Tukwila Station	Potential Sounder commuter rail riders who work near Tukwila Station	Vansharing helps make riding Sounder feasible for workers near the Tukwila Sounder station, where transit service from the station to worksites is limited. Commuters could bridge this gap by vansharing from the station to worksites.

Assessing affects of strategies and lessons learned

Promote carpooling

WSDOT contracted with King County Metro to conduct outreach and provide incentives to encourage people to carpool.

Results

Participants were asked to document their trips and mode of travel as well as some basic questions about their historical travel patterns. The promotion reduced 142 of the 330 trips targeted. These trip reductions were based on participants who indicated they were new to shifting to an alternate mode. In addition, the original targets were based on an ability to recruit 2,000 new registrants to a carpool calendar tracking program. Actual new registrations reached about half this goal.

Lessons learned

1. Continue to improve traveler information and rideshare matching systems

The next generation of traveler information systems should integrate traffic information and information about travel options and rideshare matching. These systems, currently in development, will also allow more targeted marketing, including incentives for travelers on specific corridors and messaging.

Outreach to residents

King County Metro provided one-on-one support to residents in central Renton and Renton Highlands to help them make choices about how they travel for non-commute and commute trips.

Results

The program removed 95 single occupant vehicles of the targeted 183. The two neighborhoods had very different participation rates -- Central Renton (9%) and Renton Highlands (5%).

Lessons learned

2. Effectiveness of residential outreach is highly variable

Potential neighborhoods should be carefully evaluated to develop expected outcomes based on previous experiences and specific neighborhood characteristics (density, walkability, transit availability, accessible retail, and local program support). As programs of this type continue we should collect further data to develop a trend analysis.

Outreach to Bellevue employers

King County Metro worked with Bellevue's TransManage to reach out to employers in downtown Bellevue. Quarterly mailings to all downtown businesses encouraged participation in workshops about employee commute benefits. Employers were offered individualized assistance in developing a customized commute benefits program that would work for them. Sixty two companies participated in the workshops; 39 of those companies initiated commute benefits programs ranging from employee commute planning to purchase FlexPasses. Over 1,000 employees gained access to the FlexPass program as a direct result of this outreach.

Results

About 264 single occupant trips were reduced, exceeding the goal of 171.

Lessons learned

3. Additional outreach can be effective

WSDOT's existing Commute Trip Reduction (CTR) program targets employers with 100 or more employees who commute during rush hours. Other programs, including WSDOT's Growth and Transportation Efficiency Centers (GTEC) and local transportation management associations, expand outreach to include employers with fewer employees and employees who travel outside of rush hours. Despite these efforts, there are still significant trip reduction program opportunities via employers with fewer than 100 employees who commute during rush hours.

Outreach to south King County employers

King County Metro conducted extensive outreach to employers in south King County to encourage them to offer transit, vanpool and vanshare subsidies to their employees. Employers were targeted through mailings and workshops about employee commute benefits. Employers were offered individualized assistance in developing a customized commute benefits program that worked for them. WSDOT leveraged King County Metro's efforts through the South King County Transportation Network. The network includes small businesses, community organizations and individuals from unincorporated King County and Tukwila, SeaTac, Federal Way, Auburn, Kent and Renton. This network provides transportation information tailored to south King County businesses, residents and commuters. Local media coverage of this area is limited due to the demise of local newspapers and significant staff and news bureau reductions by other local media outlets.

Results

About 163 single occupant vehicle trips were reduced. This exceeded the goal of 135.

Lessons learned

4. Leverage existing resources

In areas without TMAs, local governments can help reach commuters through the employer with TDM resources to achieve trip reductions.

In areas without TMAs you may need to look to other resources such as cities or counties to reach the audiences you need to target.

Relocate vanpools

WSDOT contracted with King County Metro to relocate 18 vanpools to redeem up to 180 parking spaces at crowded, transit-oriented park and rides. Relocating vanpools from transit-oriented park and ride lots to park and pool lots without transit service provides additional parking for transit users while maintaining vanpool participation. Financial incentives were offered to vanpool groups who were willing to move to park and pool lots.

Results

Seventeen vanpools (139 people) were relocated for one year, reclaiming 51 spaces at Wilburton and South Bellevue park and rides and 88 from the Renton Transit Center and South Renton park and ride. This relocation increased the availability of parking for transit users, drawing more users than were relocated. After the relocation, according to King County Metro's quarterly park and ride reports, on average 180 additional vehicles were at the park and rides. The relocation of vanpools met the trip reduction target. WSDOT spent \$54,000 to relocate the 17 vanpools (139 people).

Lessons Learned

5. Relocating vanpools is an inexpensive way to free up park and ride space

This is a highly effective program in areas with crowded park and rides. Relocating vanpools is a relatively inexpensive way to free up park and ride space and is less expensive than constructing a single parking space (which is about \$25,000).

6. Freeing up space at crowded park and ride lots encourages more ridesharing

King County Metro's park and ride utilization report showed that the empty parking stalls created by the vanpool relocation program increased parking availability and attracted more users than were relocated.

7. Vanpool relocation can be done relatively quickly

Vanpool relocation can be done relatively quickly. It takes about 30 days to relocate vanpools, from start to finish.

These results support the lessons learned in the Kirkland mitigation program.

Outreach to Bellevue employees (hospitality program)

King County Metro partnered with Bellevue's TransManage to conduct targeted outreach to Bellevue area employees in the hospitality industry including hotels, restaurants and retailers. Most of these employers are not required to participate in CTR.

Results

This project removed 92 round trips per day nearly reaching the target of 108.

Lessons learned

8. Expand materials to other languages

Many hospitality employees are non-English speakers. Future programs could be made more accessible by translating program materials into other languages.

9. Use existing networks whenever possible

Using existing networks, such as a transportation management association, is an effective solution to reaching employees. The use of an existing network allows faster, cheaper and more effective opportunities for conducting outreach focused on reducing trips. This particular program was focused on a niche market that was being targeted for the first time.

Install and promote bicycle lockers

WSDOT contracted with King County Metro to install lockers for a total of 16 bicycles at the South Bellevue, Newport Hills, Eastgate, Renton Highlands and Renton Transit Center park and rides. This strategy can increase the efficiency of the park and ride lots. The lockers became available June 2008.

Results

Adding the bicycle lockers removed 7 daily single occupant vehicle trips and freed up parking space for other transit riders. We spent \$16,235 to add lockers for 16 bicycles.

Lessons learned

10. Early installation of lockers improves performance during construction

The installation of bicycle lockers should precede construction activities by some period to allow time for locker rentals to develop.

11. Bicycle lockers effectiveness is weather dependent

The use of the lockers is highly dependent on the weather. During the summer months at the height of construction activities, the weather is more favorable for bicyclists, increasing park and ride capacity when it is needed most for construction mitigation.

12. Explore potential for lockers that do not require a formal rental process

King County Metro is exploring the possibility of bicycle lockers that are not rented to a specific user but rather are a first come first serve setup. This could potentially promote greater use but would require policy discussions.

13. Bike facilities remain once construction is completed

These bicycle lockers remain in use and provide a public benefit long after construction is done.

Promote vanshare

To make riding Sounder to the Tukwila station feasible for commuters, WSDOT contracted with King County Metro to promote vansharing and recruit six new vanshare groups to bridge the gap between the Sounder station and worksites. Vansharing is the use of a commuter van for a short portion (10 miles or less) of a commuter's trip between work and a transit connection or between home and a transit connection.

During previous construction traffic mitigation on I-405 in Kirkland, we attempted a vanshare program that would bridge the gap between a commuter's home and a transit hub. This vanshare program did not deliver hoped for results. We obtained far better results with this vanshare program that bridged the gap between a transit hub (Tukwila Sounder station) and worksite.

Results

The project exceeded expectations forming 13 vanshare groups with 65 riders reducing 52 trips. These vans took commuters from the Tukwila Station to their Renton worksites.

Lessons learned

14. Under the right conditions, vanshare works well as a connection between transit hub and work site.

It is inexpensive, convenient and predictable when paired with commuter rail. About 500 people daily traveled Sounder commuter rail to Tukwila. Vanshare worked for many of those commuters by bridging the gap between the Tukwila Sounder station and their work sites.

Incident response

The I-405 Renton Stage 1 and South Bellevue Widening projects required lane narrowing and reduced shoulders. In areas where full shoulders were eliminated due to construction, incidents such as stalled vehicles or minor accidents could not clear to the shoulder and would block a lane of traffic until cleared. By quickly removing blocking incidents from the road, we reduce the chance of secondary collisions occurring, which improves safety and traffic flow on the road. This is especially critical in construction zones where shoulders are limited and workers are doing their jobs close to moving traffic.

Results

Overall the number of incidents served within the I-405 corridor increased during construction compared to an equivalent period before construction, with a slight decrease in the average clearance time of 16-minutes per incident. Within the construction zones the number of incidents blocking increased about 41-percent (Renton 257 to 370 and Bellevue 276 to 380) compared to approximately an 8-percent increase in the corridor outside of the construction zones. This is likely the result of drivers not being able to clear to the narrowed shoulders within the construction zone. The total number of incidents within the construction zones increased about 12-percent (Renton 696 to 775 and Bellevue 975 to 1,103) compared to approximately a 17-percent increase in the corridor outside of the construction zones. Average clearance times within the construction zone increased in Renton from 14-minutes to 18-minutes and remained the same for Bellevue at 18-minutes. This could be attributed to the increase in the number of blocking incidents which can hinder responder arrival due to traffic back-ups and may take longer to clear.

Lesson learned

15. Incident response improves traffic flow

Incident response is an effective component of maintaining traffic flow and safety within construction zones. The services also provide benefits beyond the construction zone as the additional incident response vehicle roams the entire corridor providing increased assistance.

Commute Trip Reduction

Washington State's Commute Trip Reduction (CTR) Law was adopted by the 1991 legislature and incorporated into the Washington Clean Air Act as RCW 70.94.521-551. The intent of the CTR program is to improve air quality, reduce traffic congestion, and reduce the consumption of petroleum fuels by working with major employers to encourage employees to commute without driving alone. Employers with 100 or more full-time employees at a single worksite who begin their workday between 6 a.m. and 9 a.m. must develop a program to reduce their employee's drive-alone trips. CTR benefits such as transit fare subsidies, flexible work schedules, telework opportunities, and more are offered by employers. Worksites may or may not be required to participate in the CTR program based on their changing number of employees.

Results

We compared the Bellevue and Renton CTR worksites in 2005 (baseline) to 2007. To ensure consistency we compared the same worksites from before (as the baseline) and during construction. We found an additional 1,232 round trips (223 in Bellevue and 1,009 in Renton) were reduced on average daily at CTR worksites during project construction in 2007.

The number of vehicle trips removed through the CTR program is found by taking drive-alone rates for CTR and non-CTR worksites in east King County (77 percent¹) and comparing them to the drive-alone rates for CTR worksites within Bellevue (66 percent²) and Renton (75 percent³). This results in a conservative estimate since the overall east King County drive-alone rate includes both CTR and non-CTR worksites. With nearly 60,000 employees at Bellevue and Renton CTR worksites in 2007, the reduced drive-alone rate for CTR sites overall equals nearly 3,150 round trips reduced daily (2,345 in Bellevue and 802 in Renton). Although this program was not funded by I-405 construction mitigation funds, it provided benefits to the corridor during construction and beyond.

Vanpool

Twenty transit agencies around the state offer vanpooling as a commute option, with the majority of the daily vanpool riders in central Puget Sound. Vanpooling is more flexible than fixed route transit since it costs less to operate and can provide transportation options to employees in areas that have limited or no bus service. Once formed, many vanpools may last for years. Transit staff members are available to help people form vanpools and to keep seats filled so that vans continue to be cost-effective for commuters.

The Washington State Legislature established the statewide Vanpool Investment Program in 2003 to help reduce traffic congestion, reduce vehicle miles traveled, and improve air quality. This program helped transit agencies nearly double their vanpool ridership since 2003. WSDOT purchases vans for public transit agencies to operate and works with the agencies and employers in their community to offer incentives to increase vanpool use. Washington State has the largest vanpool program in the country.

¹ PSRC 2006 Household Travel Survey single occupant vehicle (SOV) rate for work trips for east or south King County. This rate includes CTR and non-CTR worksites.

² WSDOT Commute Trip Reduction program.

³ WSDOT Commute Trip Reduction program.

WSDOT contracted with King County Metro to help support the *Fill It Up Again!* program throughout the region. King County Metro conducted outreach and provided incentives to attract new vanpool drivers, bookkeepers, and recruit new participants. The program provided benefits to the entire Puget Sound region, which included the I-405 corridor.

Results

Metro distributed more than 4,300 incentives during the *Fill It Up Again!* program which ran from January to September 2008. Funding for incentives to attract new vanpoolers ran out mid-way through the program. This program resulted in a net increase of 148 vanpool/vanshare groups in King County, of which 55 were in Bellevue or Renton. This increase was due in large part to rising gas prices that reached nearly \$5 a gallon. Community, Pierce, Intercity and King County Metro transits all experienced an increase in vanpooling of between 11 and 17 percent during this time.

During the I-405 construction for south Bellevue and Renton Stage 1 between 275 and 500 vanpools traveled through one of the work zones daily, reducing somewhere in the range of 2,200 to 3,500 round trips each day. This is an increase of 360 to 560 daily round trips reduced by vanpools compared to October 2007 at the beginning of construction.

I-405 construction mitigation funds contributed to the *Fill It Up Again!* program. This is partially responsible for the growth in vanpooling on I-405. However this program leveraged WSDOT's ongoing statewide vanpool program that also provides benefits to the corridor during construction and beyond.

Lessons learned

16. Consistent communications to public

Communications regarding construction mitigation programs should be carefully coordinated to ensure all program partners are giving the same message to the public.

17. Adjust incentives when gas prices change

The price of gas can be an incentive for people to vanpool. When gas prices rise, so does the demand for vanpooling. When gas prices fall, incentives can be used to keep people vanpooling. Even losing a couple of riders can cause an existing vanpool to fold.

18. If possible, tap into existing region wide programs

Leverage WSDOT dollars by supporting existing region wide TDM programs. The region wide *Fill It Up Again!* campaign, the CTR program, and statewide vanpool programs were existing programs that provided benefits during the I-405 corridor construction.

19. Use global issues to your advantage

When developing a construction demand management program, determine the issues affecting commuters, the environment, traffic congestion, economic climate, etc. Then create a program to address those issues. For example, during this project, gas prices were near \$5 a gallon. Many people began commuting by riding the bus, carpooling, vanpooling, teleworking, bicycling and walking to save money.

Appendix

Construction Mitigation Target Calculation

The target setting methods outlined below are based on the construction traffic conditions of the Renton Stage 1 and South Bellevue projects. The construction traffic conditions of other projects should be evaluated individually to determine the appropriate methodology for setting construction mitigation targets.

1. Using data from the traffic collection devices on the freeway system, determine the performance (volume and speed) of the general purpose lanes during the peak periods before construction.

General Purpose Lanes Performance (May 2007)									
		AM Peak Period				PM Peak Period			
			6-7am	7-8am	8-9am	3-4pm	4-5pm	5-6pm	6-7pm
Northbound	Renton Stage 1	Volume (vpl)	1,209	1,142	1,063	1,336	1,312	1,294	1,317
		Speed (mph)	54	49	48	38	36	34	42
	South Bellevue	Volume (vpl)	1,908	1,926	1,794	1,761	1,650	1,587	1,416
		Speed (mph)	54	46	38	54	58	57	58
Southbound	Renton Stage 1	Volume (vpl)	1,558	1,523	1,472	1,396	1,390	1,348	1,346
		Speed (mph)	49	48	49	47	47	47	52
	South Bellevue	Volume (vpl)	1,374	1,404	1,320	1,374	1,216	1,205	1,298
		Speed (mph)	54	51	49	24	16	16	21

2. Calculate pre-construction and construction condition theoretical capacities of the lanes through the construction zones utilizing the principles of the Highway Capacity Manual.

Theoretical Capacity Calculation*										
		Northbound						Southbound		
	Beginning Location	Ending Location	BMP	EMP	Number of Lanes	Capacity (Current) vphpl	Capacity (Construction) vphpl	Number of Lanes	Capacity (Current) vphpl	Capacity (Construction) vphpl
Renton Stage 1	I-5	SR-167	0.00	2.77	2	2,260	2,200	2	2,260	2,200
South Bellevue	I-90	SE 8th ST	10.69	12.99	3	2,320	2,270	3	2,300	2,250

* The Highway Capacity Manual provides theoretical capacities. Actual observed conditions may vary as a result of the effects of demand on throughput and other factors. In this case since the capacities are provided for two conditions of the same roadway they are used more on a relative basis to one another for analysis purposes rather than an actual roadway capacity.

3. Calculate the volume to capacity ratio of the existing facility.

Volume to Capacity Ratio								
		AM Peak Period			PM Peak Period			
		6-7am	7-8am	8-9am	3-4pm	4-5pm	5-6pm	6-7pm
Northbound	Renton Stage 1	0.53	0.51	0.47	0.59	0.58	0.57	0.58
	South Bellevue	0.82	0.83	0.77	0.76	0.71	0.68	0.61
Southbound	Renton Stage 1	0.69	0.67	0.65	0.62	0.62	0.60	0.60
	South Bellevue	0.60	0.61	0.57	0.60	0.53	0.52	0.56

4. Review the pre-construction segment performance to determine how the facility is operating. Maximum efficiency is usually estimated at 70-percent of the posted speed. For an urban freeway the posted speed is typically 60 mph, 70-percent of which would be 42 mph. If the facility is operating below free flow speed then an increase in demand or a decrease in capacity could lower the speeds. If the speeds go below 42 mph the facility would operate inefficiently and actually move fewer vehicles.

Two factors need to be considered in analyzing the facility performance and the trip target for construction mitigation, the travel speeds and the percent of capacity lost. To prevent a loss of throughput from inefficiency caused by a reduction in capacity we have to address any periods when the speeds are below a threshold higher than the point of inefficiency such as 50mph (this accounts for the potential of speeds that are currently marginally above the point of inefficient to decrease as a result of construction and become inefficient). While there is little research regarding the interactions of multiple construction zones the effects are believed to have the potential for a cumulative impact. Therefore in situations with multiple separate construction projects the target should be estimated as a range with the threshold slightly higher at 50 to 55 mph.

5. Multiply the volume to capacity ratio of the pre-construction conditions times the estimated construction capacity to determine the construction throughput.

Construction Throughput (vehicles per lane)								
AM Peak Period					PM Peak Period			
		6-7am	7-8am	8-9am	3-4pm	4-5pm	5-6pm	6-7pm
Northbound	Renton Stage 1	1,177	1,112	1,035	1,301	1,277	1,260	1,282
	South Bellevue	1,867	1,885	1,755	1,723	1,614	1,553	1,386
Southbound	Renton Stage 1	1,516	1,482	1,433	1,359	1,353	1,312	1,311
	South Bellevue	1,344	1,374	1,292	1,344	1,189	1,179	1,270

6. For hours when the speeds are currently below the threshold the difference between the current throughput (measured volume) and the construction throughput (estimate) is the target for mitigation. Total this for all lanes and all hours for each peak period by direction. These are the one-way trips to be mitigated; however you don't have to address each of these trips individually. If an individual uses an alternate mode for their commute trip in the morning they will most likely use the same alternate mode for their return trip in the evening.

Taking the maximum of the morning or evening peak period total for each direction and summing provides the number of round trips to be targeted. For situations with multiple separate construction projects calculate the target for the range of the threshold.

The resulting target range for this project is 850 to 1,200 round trips.

Promote carpooling

Promotion of carpooling occurred from January to December 2008; 741 participants reported the trips they took by alternate mode during the program. These totals by mode were converted to trips reduced by mode using a percentage of trips resulting in actual trip reductions by mode (as an example one trip is reduced by a two person carpool resulting in 50-percent and two trips are reduced by a three person carpool resulting in 66-percent). To calculate the trips reduced by the program, the total of one-way trips reduced by all

modes was multiplied by the percentage of participants who were new to commuting by alternate mode. This was then multiplied by the number of months during the program and divided by the average number of monthly reports submitted to extrapolate the data to represent the entire period. This total number of trips reduced by the program was then converted to a daily trip reduction.

Although participants only reported their morning commute (one-way) we assume that people will take the same mode for their return trip home making these reported one-way trips the equivalent of round trips.

Data provided by King County Metro			
Alternate Mode Trips reported January to December 2008			
Mode	Alternate Mode One-Way Trips Reported by Mode Type	% of Reported Trips Resulting in Trip Reductions by Mode	One-Way Trips Reduced by Mode
Carpool - 2	41,330	50%	20,665
Carpool - 3	10,476	66%	6,914
Carpool - 4+	3,081	75%	2,311
Bus	2,083	97%	2,021
Bike/Walk	396	100%	396
Vanpool/Vanshare	1,230	88%	1,082
Train	494	98%	484
Telework	2,244	100%	2,244
Total	61,334		36,117
Participants Newness to Alternate Mode			
Time		Percentage	
0-6 months		49%	
6-12 months		16%	
1 year+		35%	
Length of Program in Months		12	
Average # of Monthly Reports Provided by Participants		6	

WSDOT Analysis

Newly Reduced Trips Attributed to Promotion Activities	
Total Trips Reduced Attributed to Promotion Reduced During Program	
$= \left(\frac{\text{Total One - Way Trips Reduced}}{\text{Trips Reduced}} \right) * \left(\frac{\% \text{ of Participants}}{0 - 6 \text{ months}} \right) * \left(\frac{\# \text{ of Months During Program}}{\text{Average \# of Monthly Reports}} \right)$	
$= (36,117) * (49.0\%) * (12 / 6) = 35,395 \text{ trips}$	
Average Daily Round Trips Reduced Attributed to Promotion Program	
$= \frac{\left(\frac{\text{Total Trips Reduced Attributed to Promotion During Program}}{\text{to Promotion During Program}} \right) * \left(\frac{\# \text{ of Months During Program}}{\# \text{ of Months Per Year}} \right)}{\# \text{ of Commute Days Per Year}}$	
$= ((35,395) * (12 / 12)) / (250)) = 142$	

Outreach to residents

King County Metro conducted outreach to central Renton from mid-June through September and to Renton Highlands from September to mid-November. Participants reported the trips they took by alternate modes during the program. Using the number of trips reported and the length of the program period an average number of trips reduced during the program period was calculated. An average number of trips reduced after the program period until the end of the contract period was calculated using the 80-percent historical average continued participation after the program period.

WSDOT Analysis

The data highlighted in green was provided by King County Metro.				
	Central Renton		Renton Highlands	
Contacts	2,400	households	3,700	households
Participants	223	people	168	people
Commute Days per Year	250			
Program Reporting Period	Mid June - September		September - Mid-November	
Total Program Period During Construction	Mid-June 2008 to December 2008		September 2008 to December 2008	
	6.5	months	4.0	months
	135	commute days	83	commute days
Length of Program Reporting Period	50	commute days	40	commute days
Total # of Logged Round Trips by Alternate Mode	3,370	round trips	2,626	round trips
Average Daily Round Trips Reduced During Reporting Period (Total Logged Round Trips / Length of the Program Reporting Period)	67	round trips	66	round trips
Estimated Continued Participation	80%			
Average Daily Round Trips Reduced After Reporting Period (Average Daily Round Trips Reduced During Reporting Period * Estimated Continued Participation)	54	round trips	53	round trips
Estimated Total Trip Reduction Mid-June 2008 - December 2008	7,976	round trips	4,902	round trips

Estimated Daily Round Trips Reduced

$$\begin{aligned}
 &= \frac{\left(\left(\text{Estimated Total Trip Reduction Central Renton 6/2008 - 12/2008} \right) + \left(\text{Estimated Total Trip Reduction Renton Highlands 6/2008 - 12/2008} \right) \right)}{\text{Total Commute Days 6/2008 - 12/2008}} \\
 &= ((7,976) + (4,902)) / (135) = \mathbf{95}
 \end{aligned}$$

Outreach to Bellevue employers

King County Metro provided data on the number of FlexPasses issued through the outreach efforts and on the alternate modeshare of FlexPass sites and non-FlexPass sites within the area. The difference between the modeshare of FlexPass and non-FlexPass sites is attributed to the introduction of a FlexPass program. The trip reductions are calculated by taking the difference in modeshare and multiplying it by the number of FlexPasses issued.

FlexPass Sales and Modeshares	
Data provided by King County Metro	
FlexPasses Issued	1,048
Alternate Modeshare for FlexPass Sites	32.0%
Alternate Modeshare for Non-FlexPass Sites	6.8%

WSDOT Analysis
Daily Round Trips Reduced by FlexPass Sales
$= \left(\left(\text{Modeshare for FlexPass Sites} \right) - \left(\text{Modeshare for Non - FlexPass Sites} \right) \right) * \left(\text{\# of FlexPasses Issued} \right)$
$= ((32.0\%) - (6.8\%)) * (1,048) = 264$

Outreach to south King County employers

King County Metro provided data on the number of FlexPasses issued through the outreach efforts and on the alternate modeshare of FlexPass sites and non-FlexPass sites within the area. This program also included outreach to promote vanpooling and vansharing. The trip reductions for the FlexPass program are calculated by taking the difference in modeshare of FlexPass and non-FlexPass sites and multiplying it by the number of FlexPasses issued. The total trip reduction includes the FlexPass, vanpooling and vansharing trip reductions.

FlexPass Sales, Modeshares and Trip Reductions	
Data provided by King County Metro	
FlexPasses Issued	2,680
Alternate Modeshare for FlexPass Sites	5.5%
Alternate Modeshare for Non-FlexPass Sites	3.0%
Vanpool Trips Reduced	19
Vanshare Trips Reduced	77

WSDOT Analysis
<p>Daily Round Trips Reduced by Flexpass Sales</p> $= \left(\left(\text{Modeshare for FlexPass Sites} \right) - \left(\text{Modeshare for Non - FlexPass Sites} \right) \right) * \left(\text{\# of FlexPasses Issued} \right)$ $= ((5.5\%) - (3.0\%)) * (2,680) = 67$ <p>Total Daily Round Trips Reduced</p> $= \left(\text{FlexPass Sales Trips Reduced} \right) + \left(\text{Vanpool Trips Reduced} \right) + \left(\text{Vanshare Trips Reduced} \right)$ $= (67) + (19) + (77) = 163$

Relocate vanpools

Relocation of the vanpools occurred between May and August 2007 and participants were required to relocate from the park and rides for one year. To calculate the daily trip reductions you first calculate an average utilization for a period before the relocation and during the relocation. The average utilization before the relocation minus the number of individuals relocated provides a baseline utilization. The trips reduced are the difference between the utilization during the relocation and the baseline utilization. This is the number of new users who were able to access the park and rides after the vanpool users relocated.

Park and Ride Quarterly Utilization 2006 - 2008										
Data provided by King County Metro's Quarterly Park and Ride Utilization Reports										
Park and Ride	Capacity	Quarterly Utilization								
		2006				2007				2008
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q
Wilburton	186	94	128	129	129	149	178	164	177	184
South Bellevue	519	548	546	553	558	539	546	541	549	549
Renton Transit Center	150	126	117	125	126	126	124	113	105	109
South Renton	373	375	373	373	373	373	373	373	376	373

WSDOT Analysis					
	Average Utilization Before Relocation 1Q 2006 through 4Q 2006	Average Utilization After Relocation 2Q 2007 through 1Q 2008	Vanpoolers who Relocated from the Park and Ride	Baseline Utilization (Average Utilization Before Relocation minus the 51 Relocated Individuals)	Daily Round Trips Reduced (Average Utilization After Relocation minus Baseline Utilization)
Wilburton and South Bellevue	671	722	51	620	102
Renton Transit Center and South Renton	497	487	88	409	78
Total					180

Outreach to Bellevue employees (hospitality program)

King County Metro worked with city of Bellevue and TransManage conducting outreach to Bellevue employees at restaurants, hotels and retail shops. TransManage provided data on the number of participants and the number of trips they reported taking by alternate modes during the program period. Using the number of trips reported and the length of the program period an average number of trips reduced during the program period was calculated. An average number of trips reduced after the program period until the end of the contract period was calculated using the 80-percent historical average continued participation after the program period.

WSDOT Analysis

The data highlighted in green was provided by King County Metro.		
Contacts	499	employees attended events
	360	mailers were sent to employers
Participants	181	people
Commute Days per Year	250	
Total Program Period During Construction	April 2008 - December 2008	
	9.0	months
	188	commute days
Length of Program Reporting Period	50	commute days
Logged Round Trips by Alternate Mode	Transit	4,792
	Rideshare	524
	Bike/Walk	65
	Total	5,381
Average Daily Round Trips Reduced During Reporting Period (Total Logged Round Trips / Length of the Program Reporting Period)	108	round trips
Estimated Continued Participation	80%	
Average Daily Round Trips Reduced After Reporting Period (Average Daily Round Trips Reduced During Reporting Period * Estimated Continued Participation)	86	round trips
Estimated Total Trip Reduction April 2008 - December 2008	17,219	round trips
<p>Estimated Daily Round Trips Reduced</p> $= \frac{\left(\begin{array}{c} \text{Estimated Total Trip Reduction} \\ 4/2008 - 12/2008 \end{array} \right)}{\left(\begin{array}{c} \text{Total Commute Days} \\ 4/2008 - 12/2008 \end{array} \right)}$ <p>= (17,219) / (188) =</p>		
		92

Install and promote bicycle lockers

Installation of the bicycle lockers was completed in June 2008 with all lockers available July 1, 2008. King County Metro provided data on locker rentals at the park and rides. Using this we estimated the average number of rented lockers provided by WSDOT since the park and rides contain a mix of Metro and WSDOT provided lockers. The percent of rented lockers was multiplied by the number of lockers provided by WSDOT for each park and ride to determine an average number of rented lockers provided by WSDOT. The trip reduction was calculated by multiplying this total times the historical use of bike lockers obtained from King County Metro which is 3.5 times per week.

WSDOT Analysis

	South Bellevue Park and Ride	Newport Hills Park and Ride	Eastgate Park and Ride	Renton Highlands Park and Ride	Renton Transit Center
Added Capacity (Funded by WSDOT)	4	4	4	2	2
Total Capacity	4	4	14	2	8

The data highlighted in green was provided by King County Metro.

According to King County Metro the historical use of bike lockers is an average of 3.5 days per week.

	South Bellevue Park and Ride	Newport Hills Park and Ride	Eastgate Park and Ride	Renton Highlands Park and Ride	Renton Transit Center
Total Rented	4	0	12	0	8
Percent Total Rented	100%	0%	86%	0%	100%
Average # of Rented Lockers Provided by WSDOT (Percent Total Rented times Added Capacity Funded by WSDOT)	4.0	0.0	3.4	0.0	2.0
Average # of Rented Lockers Provided by WSDOT for All Locations					9.4

Trips Reduced Daily (round trips)

$$= \left(\frac{\text{Average \# of Rented Lockers}}{\text{Provided by WSDOT}} \right) * \left(\frac{\text{Historical Use}}{\text{of Bike Lockers}} \right)$$

Trips Reduced Daily (round trips)

$$= (9) * (3.5 / 5) = 7$$

Incident response

Renton Stage 1

Area	Period	Number of Incidents	Blocking Incidents	Average Clearance Time
I-405 Corridor Entire Length	July 2005 - December 2006 (Before Construction)	7,758	2,084	16
	July 2007 - December 2008 (During Construction)	9,023	2,430	15
Construction Zone I-5 (0.00) to SR 169 (3.63)	July 2005 - December 2006 (Before Construction)	696	257	14
	July 2007 - December 2008 (During Construction)	775	370	18

South Bellevue Widening

Area	Period	Number of Incidents	Blocking Incidents	Average Clearance Time
I-405 Corridor Entire Length	September 2005 - December 2006 (Before Construction)	6,535	1,834	16
	September 2007 - December 2008 (During Construction)	7,780	2,081	14
Construction Zone 112th Ave SE (8.94) to SE 8th ST (12.99)	September 2005 - December 2006 (Before Construction)	975	276	17
	September 2007 - December 2008 (During Construction)	1,103	380	17

	Increase in Incidents	Increase in Blocking Incidents
Outside Construction Zones	17%	8%
Within Construction Zones	12%	41%

Commute Trip Reduction

To estimate the number of vehicle trips removed through WSDOT's ongoing CTR program, we compared drive-alone rates for east King County (includes both CTR and non-CTR worksites) to Renton and to Bellevue (both of these only include CTR worksites). This estimate is conservative since the overall east King County drive alone rate includes CTR and non-CTR worksites.

To estimate the vehicle trips removed within the Bellevue and Renton areas, we took the difference between the east King County drive alone rate and the drive alone rate for CTR sites in Bellevue and Renton and multiplied it by the number of employees at the Bellevue and Renton CTR sites. To ensure consistency, we compared the same worksites from before (as baseline) and during construction.

Bellevue CTR Worksites*					
		Number of Employees	Drive Alone Rate	Drive Alone Round Trips	((General East King Cty Drive Alone Rate) - (CTR Site Drive Alone Rate)) * Number of Employees
Bellevue CTR Worksites present in both 2005 and 2007	2005	16,864	67.3%	11,349	1,636
	2007	17,707	66.5%	11,775	1,859
	Change 2005 to 2007				223
All Bellevue CTR Worksites in 2007	2007	21,712	66.2%	14,373	2,345

General Eastside Drive Alone Rate*** 77%

Renton CTR Worksites**					
		Number of Employees	Drive Alone Rate	Drive Alone Round Trips	((General East King Cty Drive Alone Rate) - (CTR Site Drive Alone Rate)) * Number of Employees
Renton CTR Worksites present in both 2005 and 2007	2005	32,145	77.6%	24,945	-193
	2007	37,098	74.8%	27,749	816
	Change 2005 to 2007				1,009
All Renton CTR Worksites in 2007	2007	38,214	74.9%	28,622	802

General Eastside Drive Alone Rate*** 77%

The data in the shaded cells was provided by the Commute Trip Reduction program.

*CTR Database: ~2 miles on either side of I-405 from 208th St. in Bothell to 118th Ave. SE in Bellevue

**CTR Database: ~2 miles on either side of I-405, SR-518, and I-5. For I-405/SR-518 from Newcastle on I-405 to Sea-Tac airport on SR-518; for I-5 from I-5/I-405 Interchange to SR-518

***Source: PSRC 2006 Household Travel Survey drive alone rate for work trips for east or south King County. This rate includes CTR and non-CTR worksites.

Vanpools

System wide data was collected for the beginning of construction (October 2007) and after the TDM program ended (March 2009). Specific I-405 corridor data was only available for the end (March 2009) of construction. To estimate vanpools on the I-405 for the beginning of construction, we assumed that the vanpool growth on the I-405 corridor was similar to the rest of the system. Calculating the system wide growth between October 2007 and March 2009, we reduced the March 2009 data on I-405 by this growth to back-out an estimate of the October 2007 I-405 vanpools through the South Bellevue and Renton Stage 1 construction areas.

This can be converted to an estimated reduction of round trips using factors for the trips reduced in each vanpool. A high estimate uses the factor of the average ridership of a vanpool minus the driver. A low estimate uses a factor based on a survey of vanpool riders' previous modes to not count a reduced trip for a rider switching from another alternate mode such as riding the bus or in a carpool.

The data in the shaded cells was provided by vanpool operators.

Systemwide	King County Metro	Average Ridership per Vanpool	8.2
October 2007	846	High Estimate of Round Trips Reduced per Vanpool (Average Vanpool Ridership minus the Driver)	7.2
February 2009	1,007	Low Estimate of Round Trips Reduced per Vanpool (Based on survey data of previous mode of vanpool riders)	4.7
Percent Change October 2007 to February 2009	119%		

	I-405 South Bellevue				
	King County Metro	Community Transit	Pierce Transit	Intercity Transit	Total
October 2007 Vanpools	187	30	8	5	229
March 2009 Vanpools	222	36	9	6	273
	I-405 Renton Stage 1				
October 2007 Vanpools	128	6	35	8	177
March 2009 Vanpools	152	7	42	10	211

WSDOT Analysis

Round Trips Reduced				
		I-405 South Bellevue	I-405 Renton Stage 1	Total
October 2007 (beginning of construction)	High Estimate (# of vanpools times the high estimate of round trips reduced per vanpool)	1,661	1,283	2,944
	Low Estimate (# of vanpools times the low estimate of round trips reduced per vanpool)	1,078	833	1,911
March 2009 (after construction)	High Estimate (# of vanpools times the high estimate of round trips reduced per vanpool)	1,977	1,528	3,504
	Low Estimate (# of vanpools times the low estimate of round trips reduced per vanpool)	1,283	992	2,275
Change in Round Trips Reduced October 2007 to March 2009 High Estimate		316	244	560
Change in Round Trips Reduced October 2007 to March 2009 Low Estimate		205	159	364
Range of Round Trips Reduced	March 2009	1,283 to 1,977	992 to 1,528	2,275 to 3,504
	Change October 2007 to March 2009	205 to 316	159 to 244	364 to 560
Midpoint of Round Trip Reduction Range	March 2009	1,630	1,260	2,889
	Change October 2007 to March 2009	261	201	462